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PINE SAWMILLING COSTS BY LOG SIZE

An Estimating Method

by

Walter C. Anderson

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U. S. Department of Agriculture - Forest Service

FOREWORD

A simple method for estimating the cost of sawing mill-run pine lumber from logs of any size at small sawmills is described in this paper. This estimating method is based upon time-study data obtained during an investigation of the marketing of sawmill and logging residues. The investigation was made under Title II of the Research and Marketing Act of 1946. The sawing-time data were collected and analyzed for use in appraising the possibilities of reducing logging waste through the integrated sale and utilization of timber for sawlogs and pulpwood. The results of the analysis are presented here since it appeared that they would be of sufficient use to small-sawmill operators to warrant separate publication.

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PINE SAWMILLING COSTS BY LOG SIZE:

An Estimating Method

by

Walter C. Anderson

Sawmill operators know that it costs more to saw a thousand board feet of lumber from small logs than from large ones. They are quite sure some of these small logs are unprofitable, but they don't know exactly which sizes. If an operator knew which sizes don't pay, he could avoid sawing such logs and thus increase his profits.

This paper presents an easy method for estimating the cost of sawing logs by log size. The method is based upon sawing-time studies made at 25 small sawmills in the South Carolina Piedmont. These mills produced green, mill-run pine lumber, and the results of the study apply generally to small, edger-equipped sawmills of this type throughout the Piedmont.

STEPS IN FIGURING SAWING COSTS

Using the Sawing Cost Work Sheet (Form 1), small sawmill operators can calculate sawing costs for logs from 5 to 16 inches in diameter inside bark at the small end of the log, and from 8 to 16 feet in length. About 98 percent of the pine logs included in the South Carolina study fell within this range of sizes.

The figures in Columns 3 and 5 are constant values that apply to any small sawmill producing green, mill-run pine lumber. The method of computing the values given in these two columns is explained in the last two sections of this paper.

The figures in Column 2 and the total at the foot of Column 7 are to be collected and recorded by the sawmill operator. The remaining space in Columns 4, 6, and 7 is for use by the operator in calculating his cost of sawing logs of certain sizes.

To use this method of sawing-cost calculation, the operator must keep a record of the logs he saws during a full day's operation by log diameter inside bark and log length. The number of logs of each diameter and length is recorded in Column 2. For the same period he records all his costs of operation in the Cost of Operation Record (Form 2). The sum of his operating costs is then entered at the foot

Form 1.--Sawing cost work sheet

(1)		(2)	(3)	(4)	(5)	(6)	(7)
Log size		Log tally	Weighting factor	Weighted log tally	Sawing-time ratio	Multiplier	Sawing cost per MBM
Scaling diameter	Length						
Inches	Feet	Number					Dollars
5	8		108		16,700	0.4288	22.02
5	10	𝍷 1	127	127	13,100		
5	12		143		11,100		
5	14		158		9,800		
5	16		187		9,700		
6	8	𝍷 1	128	128	13,800		
6	10	𝍷 1	145	145	12,500	0.3210	16.48
6	12	𝍷𝍷 2	170	340	11,200		
6	14		189		10,200		
6	16		220		10,000		
7	8	𝍷 1	154	154	11,900		
7	10	𝍷𝍷 2	177	354	10,900		
7	12	𝍸𝍷 6	205	1230	10,000	0.2568	13.19
7	14		235		9,100		
7	16		260		8,600		
8	8	𝍷 1	190	190	10,900		
8	10	𝍷𝍷𝍷𝍷 4	217	868	9,700		
8	12	𝍸𝍷 6	245	1470	8,900		
8	14	𝍷𝍷𝍷 3	274	822	8,100	0.2080	10.68
8	16		305		7,700		
9	8		230		10,500		
9	10	𝍷𝍷𝍷 3	263	789	9,100		
9	12	𝍸𝍷𝍷 7	293	2051	8,100		
9	14	𝍷𝍷𝍷 3	322	966	7,500		
9	16	𝍷 1	359	359	7,000		
10	8		287		10,000		
10	10	𝍷𝍷 2	321	642	8,800		
10	12	𝍸𝍷𝍷𝍷 8	349	2792	7,700		
10	14	𝍷𝍷 2	383	766	7,000		
10	16	𝍷 1	412	412	6,400		
11	8		351		9,800		11.08
11	10	𝍷𝍷 2	384	768	8,400	0.2157	
11	12	𝍸 5	414	2070	7,300	0.1875	9.63
11	14		442		6,600	0.1695	8.70
11	16	𝍷𝍷𝍷 3	482	1446	6,100		
12	8		422		9,700		
12	10		450		8,000		
12	12	𝍷𝍷𝍷𝍷 4	480	1920	7,000		
12	14	𝍷 1	514	514	6,200		
12	16	𝍷𝍷𝍷 3	555	1665	5,800		
13	8		500		9,500		
13	10		526		7,800		
13	12	𝍷𝍷𝍷 3	565	1695	6,900	0.1772	9.10
13	14	𝍷𝍷 2	597	1194	6,100		
13	16	𝍷𝍷 2	623	1246	5,500		
14	8		585		9,400		
14	10		607		7,700		
14	12	𝍷𝍷𝍷 3	636	1908	6,600		
14	14	𝍷 1	669	669	5,800		
14	16	𝍷𝍷𝍷𝍷 4	715	2860	5,300		
15	8		666		9,200		
15	10	𝍷 1	705	705	7,700		
15	12	𝍷𝍷 2	740	1480	6,600		
15	14	𝍷 1	772	772	5,800		
15	16	𝍷 1	802	802	5,200		
16	8		767		9,200		
16	10		802		7,500		
16	12	𝍷 1	831	831	6,400		
16	14		869		5,600		
16	16	𝍷𝍷 2	896	1792	5,000		
		Total weighted tally =		38,942	Total operating cost =		51.35

Form 2.--Cost of operation record

Cost item	Expense (Daily basis)			
	Dollars			
LABOR COST				
Wages:				
1 Sawyer at $ 1.25 /hr. for 8 hrs.	10.00			
4 Mill hands at 75¢ /hr. for 8 hrs.	24.00			
Total wages		34.00		
Payments for labor:				
Social Security (2 % of payroll)	.68			
State Unemployment Compensation (3 % of payroll)	1.02			
Workman's insurance (3 % of payroll)	1.02			
Total payments		2.72		
Transportation for crew:				
Average distance of round trip (60 miles)				
Average running expenses, including tires, gas, oil, and repairs (5.6¢/mile)	3.36			
Average fixed expenses, including interest on investment, license, taxes, insurance, and depreciation ($2.04/day)	2.04			
Total transportation cost		5.40		
TOTAL LABOR COST			42.12	
MACHINE COST				
Power unit:				
Fuel (25 gal./day at 14 ¢/gal.)	3.50			
Crankcase oil (ave. of 1 gal./day at 90 ¢/gal.)	.90			
Antifreeze (5 gal/yr. at $ 3.75 gal.; 225 work days/yr.)	.08			
Repairs and supplies (ave. of $250/yr.; 225 work days/yr.)	1.11			
Total cost of running power unit		5.59		
Sawmill:				
Grease and marine oil (for power unit and sawmill)	.50			
Belts (ave. of $160/yr.; 225 work days/yr.	.71			
Sawbits (3 boxed/mo. at $ 11 /box; 20 work days/mo.)	1.65			
Rings (48/yr. at $ 1 /each; 225 work days/yr.	.21			
Hammering saw ($10/yr.; 225 work days/yr.	.04			
Cable ($40/yr.; 225 work days/yr.)	.18			
Sawdust chain (150 ft./yr. at 33 ¢ ft.; 225 work days/yr.)	.22			
Replace tools ($30/yr.; 225 work days/yr.)	.13			
Total cost for maintaining sawmill unit		3.64		
TOTAL MACHINE COST			9.23	
TOTAL OPERATING COST (For one day)[1]				51.35

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[1] Enter this value at foot of Column 7 in Form 1.

of Column 7.[1] Once this information is obtained, his sawing costs can be calculated as outlined below.

To illustrate, it is assumed that 96 logs were sawed into lumber (5,700 board feet) during the day. The number of logs of each size is shown in Column 2. The cost of sawing these logs ($51.35) is shown at the foot of Column 7.

The operator's first step in calculating sawing cost by log size was to multiply the number of logs of each size (Col. 2) by the weighting factor for logs of that size given in Column 3. In our sample calculation there were six 7-inch, 12-foot logs tallied, and the weighting factor for logs of this size is 205. Therefore, the calculation was 6 x 205 = 1,230 (entered in Col. 4). The sum of all these products recorded in Column 4 (38,942) was the weighted tally for the day's run of logs.

Next, the operator calculated a multiplier (Col. 6) for each size of log for which an estimate of sawing time was desired. He obtained this multiplier by dividing the sawing-time ratio (Col. 5) for that log size by the weighted tally (sum of Col. 4). The multiplier obtained for 7-inch, 12-foot logs in this example was: 10,000 ÷ 38,942 = 0.2568.

The cost of sawing a thousand board feet of lumber from a particular size of logs was obtained by multiplying the total operating cost (foot of Col. 7) by the multiplier (Col. 6) for this size of log. The cost of sawing a thousand board feet of lumber from 7-inch, 12-foot logs in this example was: $51.35 x 0.2568 = $13.19.

In this way, sawing costs can be calculated by a small-sawmill operator for any size of log. (The reader will find blank work sheets for this purpose at the end of this paper.) He is not limited in his calculation to only those sizes of logs that he has tallied and sawed. In our illustration, for instance, a sawing cost was calculated for 5-inch, 8-foot logs even though no logs of this size were included in the log tally.

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[1] It should be noted that this sum does not include fixed costs, such as depreciation charges on equipment, or the cost of moving the mill to a new location. They are excluded from this cost calculation because fixed costs are not associated with particular units of production. For instance, depreciation charges are assumed when a mill is bought, and the costs of moving a portable mill are assumed when it is set up. They have no relation to log size.

WAYS TO USE SAWING COSTS

If a sawmill operator knew his profit or loss from sawing logs of each size, this knowledge would guide him in deciding (1) what sizes of logs pay their way on his particular operation, (2) what sizes of logs would pay their way if conditions changed, e.g., if lumber prices declined by a given amount, and (3) what is the most profitable use that can be made of a log or tree section of any size.

Minimum Profitable Size of Logs

Small logs outnumber large ones on many log decks in the Piedmont, because sawmill operators can seldom select the sizes they prefer. This fact makes it important that each sawmill operator know the smallest sizes of logs he can profitably saw into lumber. To find these log sizes, he needs to know (1) the value per thousand board feet of the lumber at his sawmill, and (2) the cost of logs at his sawmill, also on a per-thousand-board-foot, lumber-tally basis. His sawing costs by log size he estimates as described above.

The value of lumber at his sawmill may be taken as its delivered price minus the prevailing rate for contract hauling. This value is $43 per thousand board feet where the average price of lumber is $48 and the contract rate for hauling lumber is $5.

The cost of logs to the sawmill operator is at a flat rate per thousand board feet when he acquires them through (1) purchase by log-scale delivered to the mill, or (2) contracting the logging of his stumpage at a fixed rate per thousand board feet. Their cost, of course, must be expressed in terms of lumber tally. This is necessary because log costs are combined with lumber value and sawing costs, both of which are in terms of lumber tally, in computing the size of the smallest profitable log. Log rules do not give a sufficiently accurate measure of the lumber content of logs for this purpose.

When the cost of logs per thousand board measure does not vary by log size, the profitable sizes of logs are determined by the relationship between two factors. These factors are (1) the dollar spread between average log cost and average lumber value, and (2) the cost of sawing the log. If logs cost $32 per thousand board feet at the mill and lumber is valued at $43 per thousand board feet at the mill, the dollar spread between them is $11. With this dollar spread, the smallest log with a sawing cost of less than $11 is the minimum profitable size of log. It can be found by the trial-and-error process of calculating sawing costs for various log sizes and comparing each cost with this dollar spread until the smallest profitable log size is found. In our example, it was an 8-inch, 14-foot log. The cost of sawing 8-inch, 14-foot logs is $10.68 per thousand board feet, and the sawing-time ratio is 8,100. Therefore, this operator can profitably saw all logs with sawing-time ratios of 8,100 or less. This includes 8-inch logs that are 14 feet long, and logs 12 inches and larger that are at least 10 feet long.

When sawlogs are cut by the operator's own crews, the cost of logs per thousand board feet is no longer the same for all sizes of logs. The reason for this is that felling, bucking, skidding, and hauling costs are all greater per thousand board feet for small logs than for large ones.

When an operator does not know his log costs by log size, he can approximate the size of the smallest log he is able to make and saw at a profit. To do this, he must find the size of his average log and his average cost of logging. For example, an operator finds that for one day the total logging cost was $68.40; the total volume of logs produced was 5,700 board feet, lumber tally; and the total number of logs produced was 96. Therefore, the average logging cost was $12 per thousand board feet and the average volume per log, 59.4 board feet. Referring to table 1, the operator found that 59.4 board feet was the average lumber content of 11-inch logs. The average cost of logging 11-inch logs was, therefore, $12 per thousand board feet. The cost of logging smaller logs was, of course, greater than this, and the cost of logging larger ones was less. If stumpage was $20 and the sawing cost for 11-inch, 12-foot logs was $9.63, the total cost of a thousand board feet of lumber from average 11-inch logs would be $41.63. It would pay him to produce lumber from logs of this size when the value of lumber at the mill was $43 per thousand board feet. With this knowledge he could intelligently estimate the smallest size of log it would pay him to make and saw. In this example, it appears that a log 10 inches in diameter would be the smallest profitable size.

Table 1.--Average log lengths and log volume by scaling diameter

Scaling diameter (Inches)	Average length	Log volume
	Feet	Board feet
5	10.3	10
6	10.6	12
7	12.1	21
8	12.5	28
9	12.7	36
10	13.0	46
11	13.1	67
12	13.3	82
13	12.7	82
14	12.9	97
15	13.5	134
16	13.7	154

Changes in the Minimum Profitable Size of Log

There is a second way in which small sawmill operators may use sawing costs by log size in guiding their operations. It is to estimate what size the smallest profitable log would be if a change occurred in such cost or receipt items as wages, stumpage prices, or lumber prices. An operator could make this estimate by merely substituting into his calculation of minimum log size the new wage or price for the previous wage or price. The minimum profitable size of log could then be calculated in the manner that has already been described.

Consider, as an example, the effect on the size of profitable logs of a decline in the average price of lumber such as occurred in the lower Piedmont of South Carolina. Between December 1953 and March 1954, the average price small sawmills received for green, mill-run pine lumber delivered to a concentration yard declined from $48 to $46 per thousand board feet. Since the average contract rate for hauling lumber is $5 per thousand board feet, the value of lumber at the sawmills fell from $43 to $41 per thousand board feet. Logs delivered to sawmills during this period sold for an average price of $32 per thousand board feet, when log price is expressed in terms of actual lumber outturn. Thus, the net effect of the decline in lumber prices was to narrow the spread between the cost of logs and the value of lumber from $11 to $9 per thousand board feet.

Some small sizes of logs that were sawed into lumber at a profit in December 1953 could be sawed only at a loss in March 1954, as long as the average daily cost of sawmill operation remained at $51.35. If the cost of operating the sawmill was reduced, some of these small logs could still be sawed at a profit. An operator could, for instance, reorganize his crew for greater efficiency. By relocating his sawmill, he could shorten the distance he must transport his crew to and from work. He could even let his sawmill deteriorate by spending less on its upkeep, although in the long run this would not be an economy. However, the extent to which he could reduce operating costs is limited, and it may be impracticable to reduce them at all.

When the average daily cost of operating a sawmill cannot be substantially reduced, the operator could limit the logs he sawed to those larger, profitable sizes. Which sizes of logs are profitable he could determine by calculating in Form 1 the smallest log sizes from which lumber can be sawed for less than $9 per thousand board feet. For this example, the adjustment an operator would have to make in the minimum sizes of logs he sawed is shown in table 2.

Most Profitable Use of Logs

A third way a sawmill operator can use sawing costs by log size is in setting up guides for the integrated use of a tree. The object would be to convert each section of the tree into that product which

Table 2.--Minimum profitable sizes of logs when the average price of lumber is $48 and when it is $46 per thousand board feet

Lumber price $48		Lumber price $46	
Minimum log diameter	Minimum log length	Minimum log diameter	Minimum log length
Inches	Feet	Inches	Feet
8	14	11	14
9	12	14	12
12	10	--	--

yielded the greatest profit or the least loss. The following example illustrates this application:

A sawmill operator who buys tree-length logs is engaged in the production of both lumber and pulpwood. He buys trees, delivered to the mill, at $32 per thousand board feet, mill tally. The value of a thousand board feet of lumber at his mill is $43. The value of a cord of pulpwood at his mill is $10. He must decide for each section of each tree whether to saw it into lumber or buck it into pulpwood.

To guide his decisions, he computes his profits or losses on lumber, using the data in Form 1, for tree sections of various diameters and lengths. As a result of his calculations, he found that he would lose $5.48 per thousand board feet on lumber sawed from 6-inch, 10-foot logs.

Logs of this size that could be sawed into 1,000 board feet of lumber could alternatively be converted into 3 cords of pulpwood. At $10 per cord, their value as pulpwood would be equivalent to $30 per thousand board feet. This is $2 less than the cost of the logs. The loss is somewhat greater when the cost of bucking these 10-foot lengths into 5-foot pulpwood bolts is included.

Comparing his alternative rates of profit (rates of loss in this example) per thousand board feet, the operator would probably decide to buck the section into pulpwood.

These are three suggested ways of using sawing costs by log size to help sawmill operators make decisions that affect their profits. Sawmill operators may, themselves, discover other ways of using sawing costs by log size to guide their operations.

DERIVATION OF THE SAWING-TIME RATIOS

The method described in this paper for computing sawing costs by log size was derived from sawing-time studies at 25 small mills sawing pine in central South Carolina. These mills appeared to be typical of those in the "roofer belt," which extends along the southern Piedmont from Virginia through Georgia. Thus, the study results are generally applicable to small sawmills over this entire area.

The 25 sample mills were selected randomly from those located within a chosen area 30 miles in radius. The only restriction placed on the sample was that no mills which produced less than half a million board feet of lumber annually were drawn. This requirement was imposed to avoid the delay involved in trying to find part-time mills in operation. Among the mills drawn were some that specialized in producing boards, some that specialized in producing 2-inch dimension, and others that produced all sizes to order.

All the sample sawmills were small. Their crews ranged in size from four to nine men, and their daily output was generally under 10,000 board feet. All but four were portables that moved from tract to tract, remaining only a few weeks at each set. They sold green, mill-run pine lumber as rapidly as it was produced and they accumulated no inventories.

There was little variation in equipment from mill to mill. All the sawmills studied had headsaws of the circular, inserted-tooth type. They were powered by Diesel engines or engines operating on kerosene. All but two of these sawmills had edgers. None had either trimmers or cut-off saws.

Collection of Data

A total of 916 pine logs were sampled--approximately 36 logs at each mill. The distribution of these logs according to size is shown in table 3.

All the pine logs in the sample were timed through the headsaw, and the time was recorded to the nearest second by log size. Time through the headsaw was considered to be the best measure of sawing time because it set the pace for all other mill operations. The sawing time for a log was defined as the interval between the time the "dog board" from the previous log was dropped from the carriage until the "dog board" from the timed log was dropped. Delay times, such as time required to file the saw or make repairs, were not included because they were not associated with log size.

Table 3.--Number of logs timed at sample sawmills, by scaling diameter and length

Scaling diameter (Inches)	Length							Total
	8 ft.	10 ft.	12 ft.	14 ft.	16 ft.	18 ft.	20 ft.	
5	14	6	12	1	2	--	--	35
6	63	32	37	15	12	2	--	161
7	29	33	76	27	30	4	--	199
8	17	25	62	36	29	1	1	171
9	3	15	56	20	15	4	--	113
10	2	10	40	17	20	--	--	89
11	1	3	24	9	11	--	--	48
12	--	3	14	9	5	--	1	32
13	--	1	17	4	3	--	--	25
14	1	--	10	4	3	--	--	18
15	--	--	7	--	4	--	--	11
16	--	--	3	1	2	--	--	6
17	--	1	1	--	2	--	--	4
18	--	1	--	--	1	--	--	2
19	--	--	1	--	--	--	--	1
20	--	--	--	--	--	--	--	--
21	--	--	--	--	--	--	--	--
22	--	--	1	--	--	--	--	1
Total	130	130	361	143	139	11	2	916

The lumber outturn of each log was tallied. This lumber was tallied in the same manner it would be when sold to concentration yards or to other local buyers. Boards that were not merchantable were rejected. Deductions were made for endtrimming. Although the lumber was not endtrimmed at the mills, it would be before it was tallied at the concentration yard. None of the lumber was graded, since none was sold on grade.

Computation of Sawing-Time Ratios

The time required to saw a log into lumber at any sawmill was assumed to be determined primarily by the size of the log and the production rate of the sawmill. The size of the log is defined by its cross-sectional area and length. The production rate of the sawmill depends, among other things, upon the size of crew and the type of product sawed.

The data were analyzed by using multiple regression techniques and graphics. This analysis showed that sawing time is positively correlated with both scaling diameter and log length. The analysis also showed that while the production rate of the sawmill affected the height of the sawing-time curves, it did not change their slope.

The average sawing times were made applicable to any sawmill by expressing them as ratios of the sawing time for the modal size of log. To calculate these ratios, the sawing time for the modal size of log (the 7-inch, 12-foot log) was assigned a value of 100. All the sawing-time ratios shown in table 4 were determined from this base value. These sawing-time ratios, because they indicate only the slope of the sawing-time curves, are the same for every sawmill. The actual time required to saw any size of log at a particular sawmill fixes the height of the sawing-time curves for that sawmill. Once this has been done, the time required to saw any other size of log at that sawmill can be determined by applying the sawing-time ratios.

Table 4.--Sawing-time ratios per thousand board feet by log scaling diameter and length

Scaling diameter (Inches)	Length				
	8 ft.	10 ft.	12 ft.	14 ft.	16 ft.
5	167	131	111	98	97
6	138	125	112	102	100
7	119	109	100	91	86
8	109	97	89	81	77
9	105	91	81	75	70
10	100	88	77	70	64
11	98	84	73	66	61
12	97	80	70	62	58
13	95	78	69	61	55
14	94	77	66	58	53
15	92	77	66	58	52
16	92	75	64	56	50

ORGANIZATION OF THE SAWING-COST WORK SHEET

Sawing time, and thus cost, varies with log size. Regardless of the size of logs sawed, however, operating costs accumulate at a steady rate during the period that the mill is running. Therefore, the cost per thousand board feet of sawing lumber from any given size of log can be calculated by translating sawing times into sawing costs. The Sawing Cost Work Sheet (Form 1) was set up for this purpose.

The objectives that guided the organization of the Sawing Cost Work Sheet were:

1. To limit the required data to a few types that could be easily collected by sawmill operators.

2. To simplify and minimize the calculations.

3. To express the calculated sawing costs by log size on a per-thousand-board-foot basis, so the costs of sawing logs of various sizes could be easily compared.

4. To enable a sawmill operator to compute the cost of sawing any size of log, whether he has sawed logs of that size or not.

The principle of calculating sawing cost by log size employed in Form 1 is to prorate the total operating cost by (1) the board feet of lumber sawed per unit of time from logs of each size, and (2) the time spent sawing logs of each size.

Given the tally of logs at a sawmill and the cost of sawing them, the prorating of sawing cost by log size might take the form shown in table 5. The tally is entered in Column 2, the total cost at the foot of Column 8. The volumes per log (Col. 3) and the sawing times per thousand board feet (Col. 5) are averages provided by the 25-mill sample (tables 6 and 7). Volume by log size (Col. 4) is merely the product of the log tally (Col. 2) and the volume per log (Col. 3). Sawing time by log size (Col. 6) is the product of the volume by log size (Col. 4) and the sawing time per thousand (Col. 5) divided by 1000. For the first group of logs in our example, this value is 242 x 64/1000 = 15.49.

Since the sawing times by log size (Col. 6) are based on the average sawing speeds of the sample mills, they may be either too high or too low for any individual mill. However, according to the analyses, the relative times by log size are the same for all mills and independent of mill speed. Therefore, if the times in Column 6 are summed and converted to percents, as in Column 7, these percents represent the correct distribution of the total sawing cost ($11 in our example) by log size. This distribution is shown in Column 8, and is converted to a per-thousand-board-foot basis in Column 9 (Col. 8 divided by Col. 4 and multiplied by 1000).

Table 5.--Sawing cost work sheet, long form

(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log size		Log tally	Volume per log	Volume by log size	Sawing time per MBF	Sawing time by log size	Sawing time by log size	Sawing cost by log size	Sawing cost per MBM
Scaling diameter	Length								
Inches	Feet	Number	Board feet	Board feet	Minutes	Minutes	Percent	Dollars	Dollars
6	16	11	22	242	64	15.49	29.4	3.23	13
9	14	18	43	774	48	37.15	70.6	7.77	10
All sizes				1016		52.64	100.0	11	

Table 6.--Lumber outturn per log by scaling diameter and length

(In board feet)

Scaling diameter (Inches)	Length: 8 ft.	10 ft.	12 ft.	14 ft.	16 ft.
5	6	10	13	16	19
6	9	12	15	19	22
7	13	16	21	26	30
8	17	22	28	34	40
9	22	29	36	43	51
10	29	37	46	54	64
11	36	46	56	67	79
12	44	56	68	82	96
13	52	67	82	98	114
14	62	79	97	116	135
15	72	92	113	134	155
16	83	107	130	154	179

In drawing up the Sawing Cost Work Sheet (Form 1), the calculation just described was altered by substituting sawing-time ratios for average sawing times in minutes and simplified by combining constants. Actual sawing times were employed in table 5 just to make the explanations easier, and it is only the relation between times that is significant. This relation is expressed by the sawing-time ratios.

Table 7.--Sawing time per thousand board measure by log scaling diameter and length

(In minutes)

Scaling diameter (Inches)	Length				
	8 ft.	10 ft.	12 ft.	14 ft.	16 ft.
5	107	84	71	63	62
6	88	80	72	65	64
7	76	70	64	58	55
8	70	62	57	52	49
9	67	58	52	48	45
10	64	56	49	45	41
11	63	54	47	42	39
12	62	51	45	40	37
13	61	50	44	39	35
14	60	49	42	37	34
15	59	49	42	37	33
16	59	48	41	36	32

The first simplification was to combine the volume per log and the sawing-time ratio into one weighting factor (Col. 3 of table 8), which was rounded off to three significant digits. A second simplification was to introduce a multiplier (Col. 6) into the calculation. This value is obtained by dividing each sawing-time ratio (Col. 5) by the weighted log tally (sum of Col. 4). Use of the multiplier obviates the need for computing percents, such as were needed in Column 7 of the original calculation (table 5). Finally, zeros were added to the sawing-time ratios so the multiplier would yield sawing costs per thousand board feet when multiplied by the total operating cost.

Table 8.--Sawing cost work sheet, short form

(1)		(2)	(3)	(4)	(5)	(6)	(7)
Log size		Log tally	Weighting factor	Weighted log tally	Sawing-time ratio	Multiplier	Sawing cost per MBM
Scaling diameter	Length						
Inches	Feet	Number					Dollars
6	16	11	220	2420	10,000	1.2171	13
9	14	18	322	5796	7,500	0.9128	10
All sizes				8216			11

Form 2.--Cost of operation record

Cost item	Expense (Daily basis)
	Dollars
LABOR COST	
Wages:	
Sawyer at $ /hr. for hrs.	
Mill hands at ¢ /hr. for hrs.	_____
Total wages	
Payments for labor:	
Social Security (% of payroll)	
State Unemployment Compensation (% of payroll)	
Workman's insurance (% of payroll)	_____
Total payments	
Transportation for crew:	
Average distance of round trip (miles)	
Average running expenses, including tires, gas, oil, and repairs (¢/mile)	
Average fixed expenses, including interest on investment, license, taxes, insurance, and depreciation ($ /day)	_____
Total transportation cost	_____
TOTAL LABOR COST	
MACHINE COST	
Power unit:	
Fuel (gal./day at ¢/gal.)	
Crankcase oil (ave. of gal./day at ¢/gal.)	
Antifreeze (gal./yr. at $ gal.; work days/yr.)	
Repairs and supplies (ave. of $ /yr.; work days/yr.)	_____
Total cost of running power unit	
Sawmill:	
Grease and marine oil (for power unit and sawmill)	
Belts (ave. of $ /yr.; work days/yr.	
Sawbits (boxed/mo. at $ /box; work days/mo.)	
Rings (/yr. at $ /each; work days/yr.	
Hammering saw ($ /yr.; work days/yr.	
Cable ($ /yr.; work days/yr.)	
Sawdust chain (ft./yr. at ¢ ft.; work days/yr.)	
Replace tools ($ /yr.; work days/yr.)	
Total cost for maintaining sawmill unit	_____
TOTAL MACHINE COST	_____
TOTAL OPERATING COST (For one day)[1]	

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[1] Enter this value at foot of Column 7 in Form 1.

Form 1.--Sawing cost work sheet

(1)		(2)	(3)	(4)	(5)	(6)	(7)
Log size		Log tally	Weighting factor	Weighted log tally	Sawing-time ratio	Multiplier	Sawing cost per MBM
Scaling diameter	Length						
Inches	Feet	Number					Dollars
5	8		108		16,700		
5	10		127		13,100		
5	12		143		11,100		
5	14		158		9,800		
5	16		187		9,700		
6	8		128		13,800		
6	10		145		12,500		
6	12		170		11,200		
6	14		189		10,200		
6	16		220		10,000		
7	8		154		11,900		
7	10		177		10,900		
7	12		205		10,000		
7	14		235		9,100		
7	16		260		8,600		
8	8		190		10,900		
8	10		217		9,700		
8	12		245		8,900		
8	14		274		8,100		
8	16		305		7,700		
9	8		230		10,500		
9	10		263		9,100		
9	12		293		8,100		
9	14		322		7,500		
9	16		359		7,000		
10	8		287		10,000		
10	10		321		8,800		
10	12		349		7,700		
10	14		383		7,000		
10	16		412		6,400		
11	8		351		9,800		
11	10		384		8,400		
11	12		414		7,300		
11	14		442		6,600		
11	16		482		6,100		
12	8		422		9,700		
12	10		450		8,000		
12	12		480		7,000		
12	14		514		6,200		
12	16		555		5,800		
13	8		500		9,500		
13	10		526		7,800		
13	12		565		6,900		
13	14		597		6,100		
13	16		623		5,500		
14	8		585		9,400		
14	10		607		7,700		
14	12		636		6,600		
14	14		669		5,800		
14	16		715		5,300		
15	8		666		9,200		
15	10		705		7,700		
15	12		740		6,600		
15	14		772		5,800		
15	16		802		5,200		
16	8		767		9,200		
16	10		802		7,500		
16	12		831		6,400		
16	14		869		5,600		
16	16		896		5,000		

Total weighted tally =

Total operating cost =

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